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**Surface chemical analysis — Depth  
profiling — Method for sputter rate  
determination in X-ray photoelectron  
spectroscopy, Auger electron  
spectroscopy and secondary-ion mass  
spectrometry sputter depth profiling  
using single and multi-layer thin films**

*Analyse chimique des surfaces — Profilage d'épaisseur — Méthode  
pour la détermination de la vitesse de pulvérisation lors du profilage  
d'épaisseur par pulvérisation en spectroscopie de photoélectrons par  
rayons X, spectroscopie d'électrons Auger et spectrométrie de masse  
des ions secondaires à l'aide de films minces multicouches*



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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 201, *Surface chemical analysis*, Subcommittee SC 4, *Depth profiling*.

This second edition cancels and replaces the first edition (ISO 17109:2015), which has been technically revised.

The main changes are as follows:

- in 4.5, reference documents for a cleaning of thin film surface have been added;
- the flowchart in Clause 5 has been revised to improve clarity.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

## Introduction

The sputtering rate in surface chemical analysis is generally determined from the quotient of sputtered depth, measured using stylus profilometry, and sputtering time. However, for multi-layered thin films, only the average sputtering rate is determined by this method. Therefore, this method is difficult to apply to multi-layered thin films comprised of materials with different sputtering rates. Sputtering rates are also affected by various experimental parameters so that it is difficult for them to tabulate and to be used for sputter depth calibrations. For higher accuracies, it is important for sputtering rates to be determined under specific experimental conditions for each laboratory for sputter depth calibration. Sputter rates should be determined using single-layers that are much thicker than the projected range of the sputtering ions so that the surface transient effect is negligible or by using multi-layered thin films where the effect of surface transient phenomena can be excluded, and interface transients can be minimized.

This document is developed for the calibration of sputtered depth by determining the ion sputtering rate for depth profiling measurement with Auger electron spectroscopy (AES), X-ray photoelectron spectroscopy (XPS), and secondary ion mass spectrometry (SIMS) using single- and multi-layer thin films. The measured ion sputtering rate can be used for the prediction of ion sputtering rates for a wide range of other materials so that depth scales or sputtering times can be estimated in day-to-day samples through tabulated values of sputtering yields and bulk densities.



# Surface chemical analysis — Depth profiling — Method for sputter rate determination in X-ray photoelectron spectroscopy, Auger electron spectroscopy and secondary-ion mass spectrometry sputter depth profiling using single and multi-layer thin films

## 1 Scope

This document specifies a method for the calibration of the sputtered depth of a material from a measurement of its sputtering rate under set sputtering conditions using a single- or multi-layer reference sample with layers of the same material as that requiring depth calibration. The method has a typical accuracy in the range of 5 % to 10 % for layers 20 nm to 200 nm thick when sputter depth profiled using AES, XPS and SIMS. The sputtering rate is determined from the layer thickness and the sputtering time between relevant interfaces in the reference sample and this is used with the sputtering time to give the thickness of the sample to be measured. The determined ion sputtering rate can be used for the prediction of ion sputtering rates for a wide range of other materials so that depth scales and sputtering times in those materials can be estimated through tabulated values of sputtering yields and atomic densities.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 14606, *Surface chemical analysis — Sputter depth profiling — Optimization using layered systems as reference materials*

## 3 Terms, definitions, symbols and abbreviated terms

### 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

#### 3.1.1

##### **upper plateau**

region exhibiting intensities higher than 95 % of the maximum intensity of the characteristic signal for that layer and covering more than half the thickness of that layer

#### 3.1.2

##### **lower plateau**

region exhibiting intensities lower than the minimum intensity plus 5 % of the maximum intensity of the characteristic signal for that layer and covering more than half the thickness of that layer